A C 170-6C

D A T E 2/13/81

# ADVISORY. CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

***Subject:*** USE OF RADIONAVIGATION LAND TEST STATIONS AND SIGNAL GENERATORS

## CHAPTER I. GENERAL

**1.** *PURPOSE.* **Information vital to** all **users** *of* radionavigation land **test stations is** nov incorporated in **Parts** 2 and *87* **of the Federal Communications Commission's** (FCC) Rules and Regulations **(47 CFR,** Sections 2 end 87). **This** circular gives **information as to the frequencies** on vhich **the** FCC **will license** these stations within the scope **of its** regulations. **This** ● **dvirory** circular also discusses the potential source **of electromagnetic** interference: presented by signal generators and hov this **interference** can *be* alleviated. **We** hope that users of signal generators **will** examine **their** operations and modify those vhich could interfere with ● **eronrutical services.**

2. CANCELLATION. Advisory Circular **170-6B** dated **3/14/78** is canceled.

*3.* INTERFERENCE WITH AERONAUTICAL SERVICES. **The Federal** Aviation Administration **(FAA)** goes to great length to provide **an interfereace-free** air traffic control environment. With a **safety service, it is** not sufficient to depend pa correcting interference problems after **they** occur. It is a basic *FM* **objective** to prevent interference from occurring by every means **poss** ible . With authorized transmitter stations, a number of techniques are used tc preclude interference. With rignal generators, hovever, only **a** fev techniques for avoiding interference are **sufficiently** fail-safe tc **be** considered practical.

**Initiated by: ARD-450**

## CHAPTER 2,. RADIONAVIGATION LAND TEST STATIONS

4. BACKGROUND - RADIONAVIGATION LAND TEST STATIONS. A radiated teet ● ignel is ● omatimss useful *for* checking navigation receivers; i.e., VOR, localitcr, glide elope, DME, ● tc., without removing them from tbe ● ircreft. Uncontrolled radiation of such test signals creates a potential hazard ● ince it may cause error8 ✂■ ● ircraft receiver8 tuned to operating navigational facilities. Authorized receiver test facilities ● re ● rrigned ● pecific frequencies and power limit8 which are selected to ● void such interference to operating facilities.

5. PROTECTED FREQUENCIES. Radionavigation test generator8 will be licensed by the Federal Communications Commission to operate on the following frequencies with up to 1 watt power output ● utbori8ation (47 CFR, Section 87.521(d); FCC Rules, Part 87, paragraph 87.521(d)).

| | |
|---|---|
| Marker | 75.0 MHz |
| VOR (X Channel) | 108.0 MHz |
| VOR (Y Channel) | 108.05 MHz |
| Localizer | 108.1 MHz |
| Glide Slope | 334.7 MHz |
| DME | 978.0 MHz |
| Beacon 1/ | 979.0 1030 MHz MHz |
| DME (Y Channel) | 1104 MHz |

6. OPERATION OF RADIONAVIGATION LAND TEST STATIONS ON FREQUENCIES OTHER THAN THE PROTECTED FREQUENCIES.

a. Under certain circumstances, Federal Communication8 Commission licenses will be issued for operation on other frequencies. Radiation on these frequencies will be restricted to a maximum field intensity level. The levels listed below have been determined to be adequate for ramp testing and nonhazardous to operational facilities (47 CFR, Section 87.521(c); FCC Rules, Part 87, parograph 87.521(c)).

b. The suggested generator outputs, to produce the specified maximum field limits at a distance *of* 100 feet using omnidirectional antenna8 attached directly to the generators, are as follows:

| Band | Maximum Field Intensity | SO ohm Generator Output |
|---|---|---|
| VOR/Localizer | 20 uv/m RMS @ 100 feet | 4 millivolt8 RMS |
| Glide Path | 60 uv/m RMS @ 100 feet | 12 millivolt8 RMS |
| DME | *600* uv/m Peak @ 100 feet | 23 millivolts Peak (.01 milliwatts Peak) |

1/ The pulse repetition rate (PRR) for the 1030 MHz ATC beacon test ret will be 235 pulse8 per second (pps) ±5 pps.

7. POWER LIMITATIONS. The power levels indicated in paragraphs 5 end 6 are maximum levels. However, FCC Ruler *require* that Radionavigation Land Test Stations be designed and operated with the minimum power necessary to satisfy requirements (47 CFR, Section 87.63(a); *FCC* Rules, Part 87, paragraph 87.63(a)). The FM supports this requirement.

8. REQUESTS FOR INFORMATION ABOUT RADIONAVIGATION LAND TEST STATIONS. Addition81 information may be obtained from the FM or the FCC et the following Washington officer or from the *FM* regional frequency management *office8* (See Appendix 1). Ques tions concerning specif ic assignments , rhould be directed to either the *Frequency* Engineering Branch of the Airway Facilities Service in Washington or to the regional frequency management offices. Questions concerning FM review of FCC Type 'Acceptance Applications rhould be directed to the Spectrum Management Branch of the Systems Research and Development Service.

Federal Aviation Administration
Airway Facilities Service
Frequency Engineering Branch, AAF-730
800 Independence Ave., S.W.
Washington, D.C. 20590

Federal Aviation Administration
Sys terns Research and Development Service
Spectrum Management Branch, ARD-450
400 Seventh Street, S.W.
Washington, D.C. 20590

Federal Coaimunications Commission
Safety and Special Radio Service Bureau
Aviation and Marine Division
Washington, D.C. 20554

## CHAPTER 3. SIGNAL GENERATORS

g. BACKGROUND - SIGNAL GENERATORS. Signal generators are used for a variety of purposes including the maintenance of aviation ground systems, avionics, and aircraft antennas. Maintenance is essential to the operation of the National Airspace System. However, the use of signal generators for maintenance and other activities can be a source of electromagnetic interference. Aviation receivers are highly sensitive. Consequently, even a very low-level radiated signal can cause disruption and interference to aeronautical services out to a substantial distance. Under some circumstances, for instance, a signal generator with an output of -30 dBW (1 milliwatt) can cause interference out to a distance of several miles. Interference is possible from both modulated and unmodulated signals. A signal generator is not an authorized station (47 CFR, Section 2.905; FCC Rules, Part 2, paragraph 2.905). Users should therefore take adequate precautions to insure that their operations do not cause disruption or interference to aeronautical services. Users should note the difference between radionavigation land test stations and signal generators. A radionavigation land test station is an authorized transmitter. Unless special temporary authorization has been obtained from the FCC, a signal generator is not. Due to these and other differences, different methods are used to preclude interference.

10. TECHNIQUES TO AVOID INTERFERENCE WITH AERONAUTICAL SERVICES. One way that signal generator users can avoid interference is simply not to connect them to antennas or other radiating devices. A second method, should radiation be unavoidable, is to confine this radiation to a shielded enclosure. This need not be a copper plated, anechoic chamber. Sometimes, the shielding provided by a typical building may be sufficient. Users should scrutinize any operation which results in the radiation of a signal (directly or indirectly) by a signal generator. In the interest of avoiding electromagnetic interference and the accompanying hazard to safety services, users should take all practical steps to avoid radiation. Radiation, in the selected bands given in Appendix 2, should be confined to shielded areas. Even then, users should minimize the duration of radiating tests, avoiding local aeronautical frequencies to the maximum extent possible, and using the lowest power necessary. A careful consideration of this matter is particularly appropriate for signal generator operations on or djkent to airports.

11. SHIELDING ADEQUACY. If the use of a signal generator results in the radiation of a signal, it is considered a restricted radistion device by the Federal Communications Commission (FCC) (47 CFR, Section 15.7; FCC Rules, Part 15, paragraph 15.7). FCC Rules and Regulations require that such equipment shall not exceed certain power limitations (see FCC Part 15, paragraph 15.7(c)). The total electromagnetic field, produced at any point away from the apparatus a distance equal to the wavelength divided by 2 pi, shall not exceed 15 microvolts per meter. (Expressed in feet, this distance is 157,000 divided by the frequency in kHz. Expressed in meters, this distance is 47,853.6 divided by the frequency in kHz.) Although the FCC

Ruler and Regulations do not explicitly prohibit the use of antennas to radiate rignal generator test signals, the field strength limitation of 15 microvolt8 per meter practically preclude8 such an operating practice unless adequate shielding is available. This 15 microvolts per meter l-imitation is recommended as a test for determining shielding adequacy. Since the enclosure itself may be larger than the distance given above, testing should be conducted at this distance from the outside of the enclosure. Testing at numerous points is recommended.

12. SIGNAL GENERATO MANUFACTURERS. The FM envision8 that signal generator manufacturers may wish to provide their customers a copy of this AC at the time of sale and/or to include its cautionary remark8 in their equipment manuals. Manfacturers could limit the distribution of this information to those signal generator8 that can tune the selected aeronautical bands shown in appendix 2.

13. REQUESTS FOR INFORMATION ABOUT SIGNAL GENERATORS. For additional information, please contact the Spectrum Management Branch of the Systems Research and Development Service at the address given in paragraph 8.

/s/ Robert W. Wedan

ROBERT W. WEDAN
Director, Systems Research
and Development Service

## APPENDIX 1. REGIONAL FREQUENCY MANAGEMENT OFFICERS' ADDRESSES

| Office | Area of Responsibility |
|---|---|
| Frequency Management Officer, AAL-430B<br>Federal Aviation Administration<br>632 Sixth Avenue<br>Anchorage, Alaska 99501 | Alaska |
| Frequency Management Officer, ACE-432<br>Federal Aviation Administration<br>001 E. 12th Street<br>Federal Building<br>Kansas City, Missouri 64106 | Iowa; Kansas; Missouri; Nebraska |
| Frequency Management Officer, AEA-426<br>Federal Aviation Administration<br>JFK International Airport<br>Federal Building<br>Jamaica, New York 11430 | Delaware; District of Columbia; Maryland; New Jersey; New York; Pennsylvania; Virginia; West Virginia |
| Frequency Management Officer, AGL-437<br>Federal Aviation Administration<br>O'Hare Lake Office Center<br>2300 East Devon Avenue<br>Des Plaines, Illinois 60018 | Illinois; Indiana; Michigan; Minnesota; Ohio; Wisconsin |
| Frequency Management Officer, ANE-464<br>Federal Aviation Administration<br>12 New England Executive Park<br>Burlington, Massachusetts 01803 | Connecticut; Maine; Massachusetts; New Hampshire; Rhode Island; Vermont |
| Frequency Management Officer, ANW-426<br>Federal Aviation Administration<br>FAA Building, Boeing Field<br>Seattle, Washington 98108 | Idaho; Oregon; Washington |
| Frequency Management Officer, APC-430.3<br>Federal Aviation Administration<br>P.O. Box 4009<br>Honolulu, Hawaii 96813 | Hawaii; Guam; Samoa |

| Office (coat) | Ares of Responsibility |
|---|---|
| Frequency Management Off iccr , ARM-406<br>Federal Avistion Administration<br>10455 East 25th Avenue<br>Aurora, Colorado '80010 | Colorado; Montana;<br>North Dakota; South Dskots;<br>Utah ; Wyoming |
| Frequency Management Officer, ASO-434<br>Federal Avistion Admiairtrstion<br>P.O. Box 20636<br>Atlanta, Georgia 30344 | Alabama; Florida; *Georgia;*<br>Kentucky; Mississippi;<br>North Carolina; South<br>Csrolins; Tennessee |
| Frequency Management Officer, ASW-406<br>Federal Aviation Administration<br>P.O. Box 1689<br>Fort Worth, Texas 76101 | Arkansas; Louisisns;<br>New Mexico; Oklahoma;<br>Texas |
| Frequency Management' Officer, AWE-406<br>Federal Aviation Administration<br>P.O. Box 92007<br>Worldway Postal Center<br>Los Angeles, California 90009 | Arizona; California<br>(including offshore<br>islands); Nevada |

## APPENDIX 2. SELECTED AERONAUTICAL BANDS.

| | | |
|---|---|---|
| 190-415 | kHz | Aeronautical Radio Beacon8 |
| 510-535 | kHz | Aeronautical Radio Beacon8 |
| 1605-1800 | kHz | Aeronautical Radio Beacons |
| 74.6-75.4 | MHz | Marker Beacons |
| 108-118 | MHz | VOR and ILS Localizcr |
| 118-137 | MHz | VHF Air/Ground Communications and Emergency Locator Transmitters (1214 MHz) |
| 225-400 | MHz | UHF Air/Ground Communications, Emergency Locator. Transmitters (243 MHz), and ILS Glide Slope (328.6-335.4 MHz) |
| 960-1215 | MHz | DME, TACAN, ATCRBS (1030/1090 MHz), Discrete Access Beacon (DABS: 1030/1090 MHz), Beacon Collision Avoidance System (BCAS: 1030/1090 MHz) |
| 1250-1350 | MHz | Air Route Surveillance Radar (ARSR) |
| 2700-2900 | MHz | Airport Surveillance Radar (ASR) |
| sooo-s2so | MHz | Microwave Landing System (MLS) |
| 5350-5470 | MHz | Airborne Weather Radar |
| 7115-7250 | MHz | Radar Microwave Link (RML) |
| 7300-797s | MHz | Radar Microwave Link (RML) |
| 8025-8400 | MHz | Radar Microwave Link (RML) |
| 9000-9200 | MHz | Precision Approach Radar (PAR) |
| 9300-9500 | MHz | Airborne Weather Radar |
| 14.4-1s .35 | GHz | Television Microwave Link (BRITE) |
| 15.7-16.2 | GHz | Airport Surface Detection Equipment (ASDE III) |
| 24.25-25.25 | GHz | Airport Surface Detection Equipment (ASDE II) |